

Volt/VAR Curve & Ride-Through Settings Guidelines

A Volt/Var curve setting is an autonomous grid support function offered by smart inverters in compliance with the IEEE 1547-2018 standard. Volt/VAR settings are the default autonomous control function for all inverter-based DERs. In “Volt/VAR mode”, also referred to as the inverter’s autonomous voltage control setting, the reactive power (absorption or injection) of the inverter is determined by Volt/VAR curve in response to the voltage measured at inverter’s point of interconnection (POI). A Volt/VAR curve is unique to an individual smart inverter or set of inverters and is calculated by PPL Electric based on DER size (kW), location on the distribution network, and locational voltage history.

Figure 1 depicts a typical Volt/VAR curve where the horizontal axis represents the per-unit voltage measured at DER POI and the vertical axis represent the injection/absorption of reactive power as percentage of DER nameplate capacity. If the POI voltage is within the V2-V3 range, the inverter will maintain 100% (unity) power factor as no control function is applied. If the POI voltage is between V1-V2, the power factor will change between 90% and 100% to inject reactive power. Conversely, if the POI voltage is between V3-V4, the power factor will change between -90% and 100% to absorb reactive power. The maximum reactive power injection/absorption happens when the POI voltage is less than V1 or larger than V4, where the power factor is set to +/- 90%. The default Volt/VAR setting ranges are listed in Table 1 below.

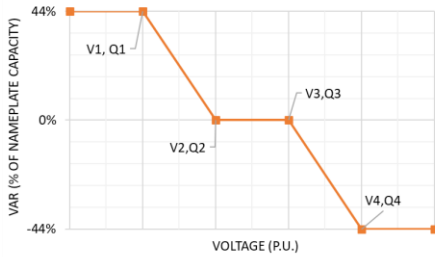


FIGURE 1: TYPICAL VOLT/VAR CURVE

TABLE 1: DEFAULT VOLT/VAR SETTING RANGE

Voltage Setpoint	Voltage Range (p.u.)	Reactive Power Setpoint	Reactive Power Ratio (%)	Operation Mode
V1	0.77 – 1.03	Q1	44%	VAR Injection
V2	0.92 – 1.05	Q2	0	Unity Power Factor
V3	0.95 – 1.08	Q3	0	Unity Power Factor
V4	0.98 – 1.23	Q4	-44%	VAR Absorption

Ride-Through

The ride-through settings are delineated to allow DERs to “ride through” or remain connected to the distribution system during voltage or frequency disturbances on the system. This is intended to help maintain the stability of the bulk electric system by allowing the centralized generators to ride-through system disturbances before DERs trip offline. The Ride-through settings include allowable voltage/frequency deviations and durations for DER smart inverters to remain connected to the distribution system before tripping offline. For more information on these guidelines, read [PPL’s voltage and frequency ride-through settings for inverter-based DERs](#).